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Fish and Wildlife Service

GULF-II SEMIAUTOMATIC PLANKTON SAMPLER FOR INBOARD USE

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The Gulf-II semiautomatic plankton sampler was used during a combination biological and oceanographic survey of the Gulf of Mexico by M/V ALASKA in the years 1951-53. The study of the distribution of plankton organisms was a part of this program, and three methods of sampling plankton were developed. Two of these have been described previously (Arnold and Gehringer, 1952).

Heterogeneous plankton distribution, or "patchiness," has long been recognized (Lucas, 1940), and I felt that an attempt should be made to study it along with the other plankton work contemplated. The best and most widely known study of plankton distribution was that of Hardy (1939) which culminated in development of the Continuous Plankton Recorder. Because this machine was not available to us, the apparatus described here was developed as a substitute method. By comparison with the Continuous Plankton Recorder it had certain shortcomings, but it also had some virtues.

DESCRIPTION

General

Basically, this sampler is a circular trough divided into 8 equal segments, each of which passes under a stream of water. The trough, or filtering pan, is rotated in the horizontal plane by a synchronous clock motor at the rate of 1 revolution in 8 hours. Each segment, or compartment, requires 1 hour to pass under the stream. The partitions have the effect of breaking the stream into hourly components, and since each compartment has a filter to catch the plankton, the plankton is separated into hourly samples. The filters are removable disks of bolting silk which are replaced each 8 hours. The apparatus receives the water from a pump situated near the keel of the vessel, with the intake through the skin of the ship at the lowest point possible. The construction and specifications are shown in the accompanying figures. The following description will be confined to points needing clarification relative to operation.

The Filtering Pan and Filters (figures 1 and 2)

The construction of the filtering pan is shown in figure 1, and its profile with an attached filter assembly on figure 2. The 1/4-inch-square head setscrew shown at the hub of the pan (fig. 1) provides a means of adjusting the angular setting of the pan.

I found that filtering tubes 12 inches long provided sufficient hydrostatic pressure to overcome the resistance of the silk and accumulated plankton organisms, except dense phytoplankton.

The U-tube welded to the bottom section of the filter assembly served to keep the liquid level above the silk filters, and so kept the sample moist. Before the filters (#1 bolting silk disks, 1-1/2 in. in diameter) were removed by loosening the hinged bolt, the fluid in the U-section was drained by removing the 1/4-inch rubber plugs.

The Tray (Figure 3)

The filtrate fell into the tray and by means of a drain and connecting hose was carried to laboratory sink, and thence, overboard. The tray was kept in place by a monel strip extending across the bottom and into the cavity of the channel frame on either side. This arrangement enabled the tray to be raised if necessary (see fig. 4). The center of the tray was fitted with a permanently attached tube extending to a point flush with the top. The shaft of the filtering pan ran through this tube to the lower journal box.

Channel Frame and Fittings (Figures 4 and 5)

The shaft was in 2 sections and coupled

as indicated in the drawing. This permitted convenient disassembly when necessary. The upper end of the shaft was drilled lengthwise to accommodate the shaft of the synchronous clock motor, and a setscrew affixed to complete the connection. These details are not shown because they vary according to the type of driving unit supplied. The journal boxes were designed to provide a bearing assembly which would minimize friction resulting from both rolling and pitching motions of the vessel.

Preservative Dispenser (Figure 6).

A pump and microswitch system was integrated with a synchronous motor which was set in phase with the filtering cycle of the sampler. Thus after each hour of filtering a given compartment of the filtering pan was flooded and rinsed with preservative, which also covered the silk disk and sample until removal. This dispensing system is simple in principle and of course is subject to many variations according to the need and facilities of the individual investigator.

The Flow Diagram (Figure 3)

This diagram indicates the flow of water from intake to waste. The intake was at an average level of 10 feet below sea surface. A stainless-steel pump powered by a 1/3-horsepower motor discharged a total of approximately 450 gallons an hour through the system, about one-fourth of which passed through the sampler. The flow could be distributed either to the waste or the sampler as desired by adjusting the 2 valves. The total discharge went through the first water meter, and the portion drawn through the sampling apparatus passed through the second water meter. This system permitted the pump to pull water from the sea at a maximum rate, thus increasing the ability of the system to entrain plankters at the intake. The 2 meters permitted a comparison of the amount of water filtered by the sampler with the total water pumped through the system.

Miscellaneous

The water meters were tropic-type disk meters, 5/8 x 3/4 inch, with a safe maximum rate of 20 gallons a minute. The manufacturer's stated error at the flow which we used was less than 1 percent. The meters were calibrated while in operation aboard ship by catching the flow in containers of known volume and no error could be detected. It is likely that a small error might have been found if facilities had permitted calibration for great quantities. The synchronour motor driving the apparatus was a small timing motor with a shaft rotation of 1 revolution in 8 hours. A mercury manometer was connected to the water supply near the discharge of the sampling stream. This provided a guide for adjusting the pressure from one run to the next.

Notes on Operation

When the vessel cleared the dock and there was no sign of harbor sediments and detritus the pump was started. While the system was allowed to clear itself by discharging through the first water meter only, the silk disks were placed in the filter assemblies, with the exception of one. When this was done the compartment for this last filter was held under the sampling stream and the water was allowed to run through to clear the line and second meter of possible contaminants. Following this the last silk was placed in the filter assembly and the apparatus was started by setting the forward partition (in the direction of rotation) for the first compartment to just clear the sample stream. At this point the setscrew connecting the filtering pan shaft to the shaft of the synchronous motor was tightened, thus setting the filtering pan in motion. The water meter readings, the time of starting, and the manometer readings were recorded.

In my experience dense masses of phytoplankton occasionally caused the silk to clog and a compartment to overflow. The operator should be on the alert for this and other difficulties so that proper entries can be made in the notes. There were times when clogging could be avoided by reducing the rate of flow of water through the apparatus, but this was avoided if possible.

After the apparatus ran 8 hours (1 hour for each compartment) it was stopped for replacing the silk filter disks. The plugs in the U-tubes were removed to permit the fluid to be

drained. The sides of the tubes were washed down with water, and then the silk disks and sample were removed and placed in a small vial of preservative without attempting to separate the captured organisms from the silk. The labels placed in the tubes carried the date, run number, and hour. These data were sufficient to locate the sample on the vessel's cruise track. New silk disks were placed in the filter assemblies, and the apparatus started again.

Remarks

The sampler described is not an ideal apparatus for quantitative plankton sampling, but it does supply us with a record of the general distribution of some of the larger plankton organisms of the Gulf of Mexico which we would not have otherwise obtained. Its advantages are that it collects continuously regardless of sea conditions, it is simple to operate, and the water flow through the apparatus is metered directly. Table 1 represents an hourly breakdown of a typical run.

The disadvantages are: Samples can be taken from only one depth; turbulence and other influences from the ship's hull have an unknown effect on quantitative collection; clogging might give trouble in more fertile waters heavily laden with plankton; the turbulence of the pump probably destroys or mutilates more fragile organisms although there was no evidence of excessive damage; the filtering rate is limited by the maximum hydrostatic head available in the tubes, hence the mesh of the silk and the flow is limited by the practical lengths of these tubes.

By way of comparison, it is illuminating to plot some results from the G-II along with some from the G-IA high-speed sampler. The latter was described by Arnold and Gehringer (1952). It was towed between hydrographic stations without removal from the water and was provided with a meter for measuring water filtered.

For comparison, the hourly values from the G-II data which corresponded to a given G-IA tow were selected and accumulated (fig. 7).

As has been pointed out, the G-II sampled constantly at approximately 10 feet below the surface as contrasted to a sampling depth of 3 to 20 meters for the G-IA. This factor alone makes comparisons of the 2 sets of data invalid, but with the extreme differences in design and operation of the two kinds of apparatus in mind the general parallelism of the 2 sets of data is striking.

I would like to suggest that the internal mechanism of the Hardy Continuous Plankton Recorder could be adapted to inboard use and would be superior to, although more complex than the apparatus described here. Such an arrangement operating continuously would contribute much to our knowledge of the relation of plankton aggregates to the congregation of fishes.

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Table 1.--June 5, 1951. Run 2. 446.2 gallons for eight hour period. Mean 56 gallons per hour. Catch, organisms per M^3.

Hour	Copepods	Sagitta	Appendicularia	Fish eggs	Other
1	-	1	-	-	-
2	8	2	-	1	
3	35	-	-	-	2
4	23	-	-	2	2
5	6	2	-	1	
6	29	1	-	-	2
7	13	2	2	1	
8	16	3	-	-	

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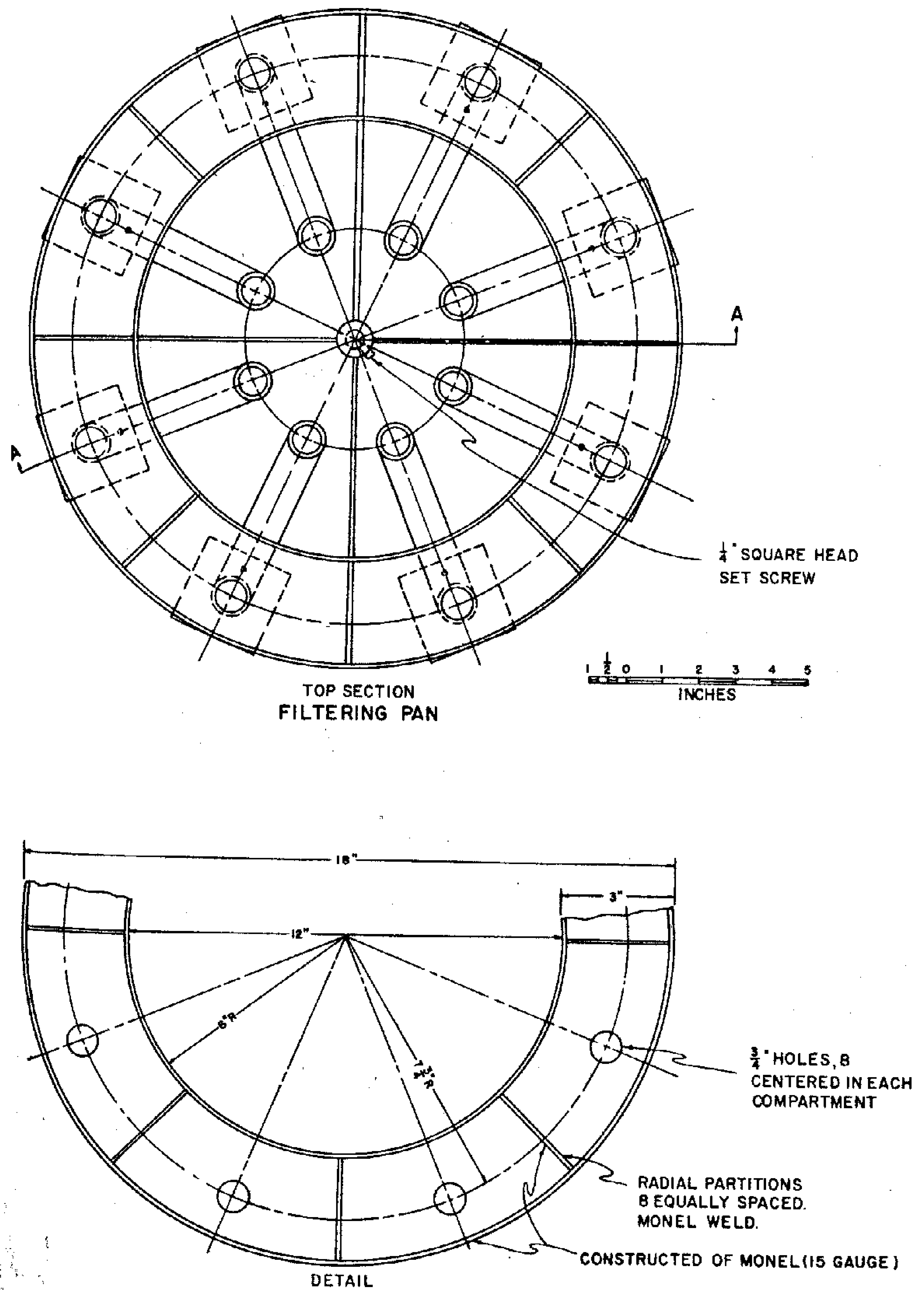

TOP SECTION
FILTERING PAN

DETAIL
FILTERING PAN

FIGURE 1

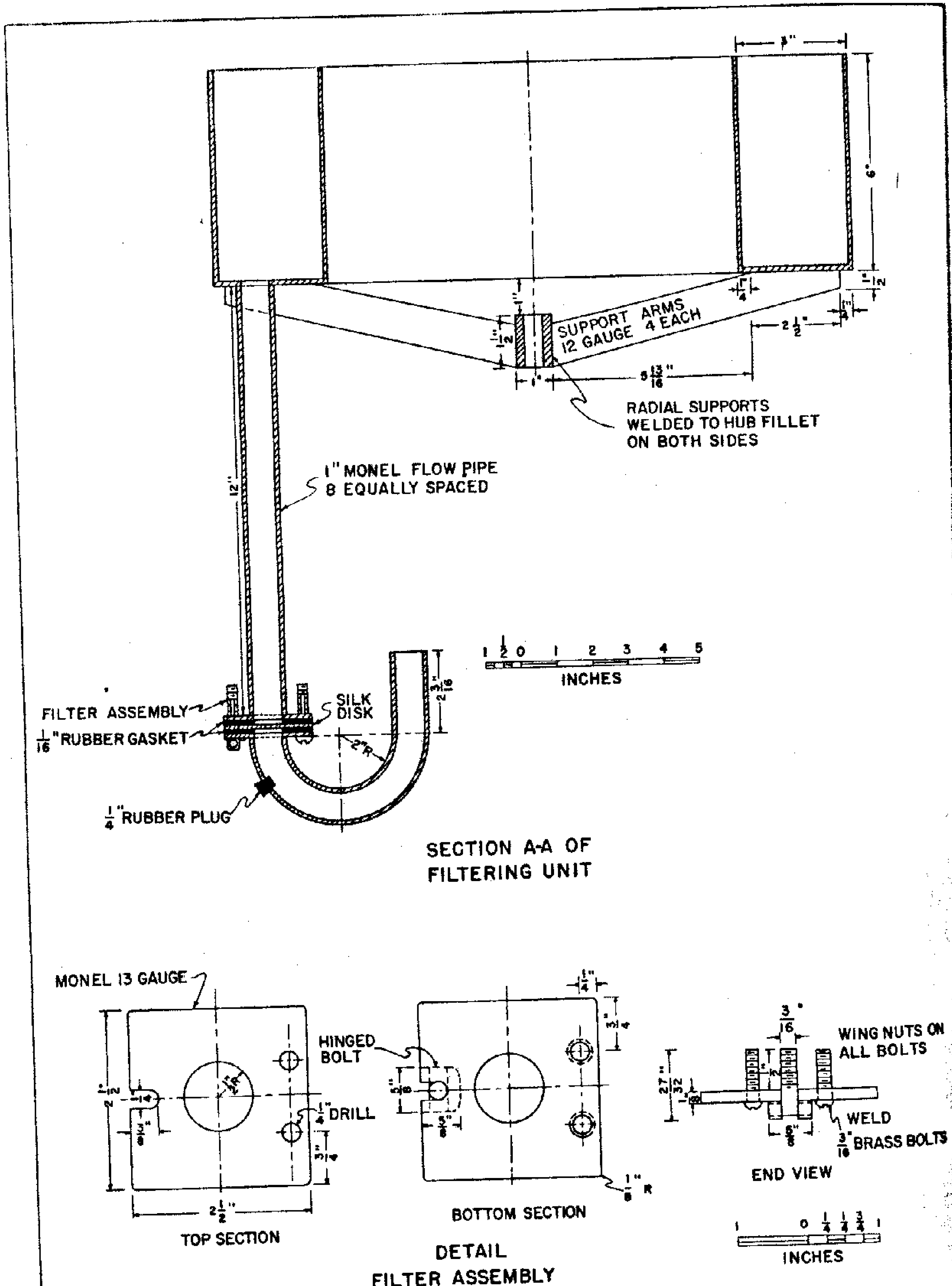

FIGURE 2

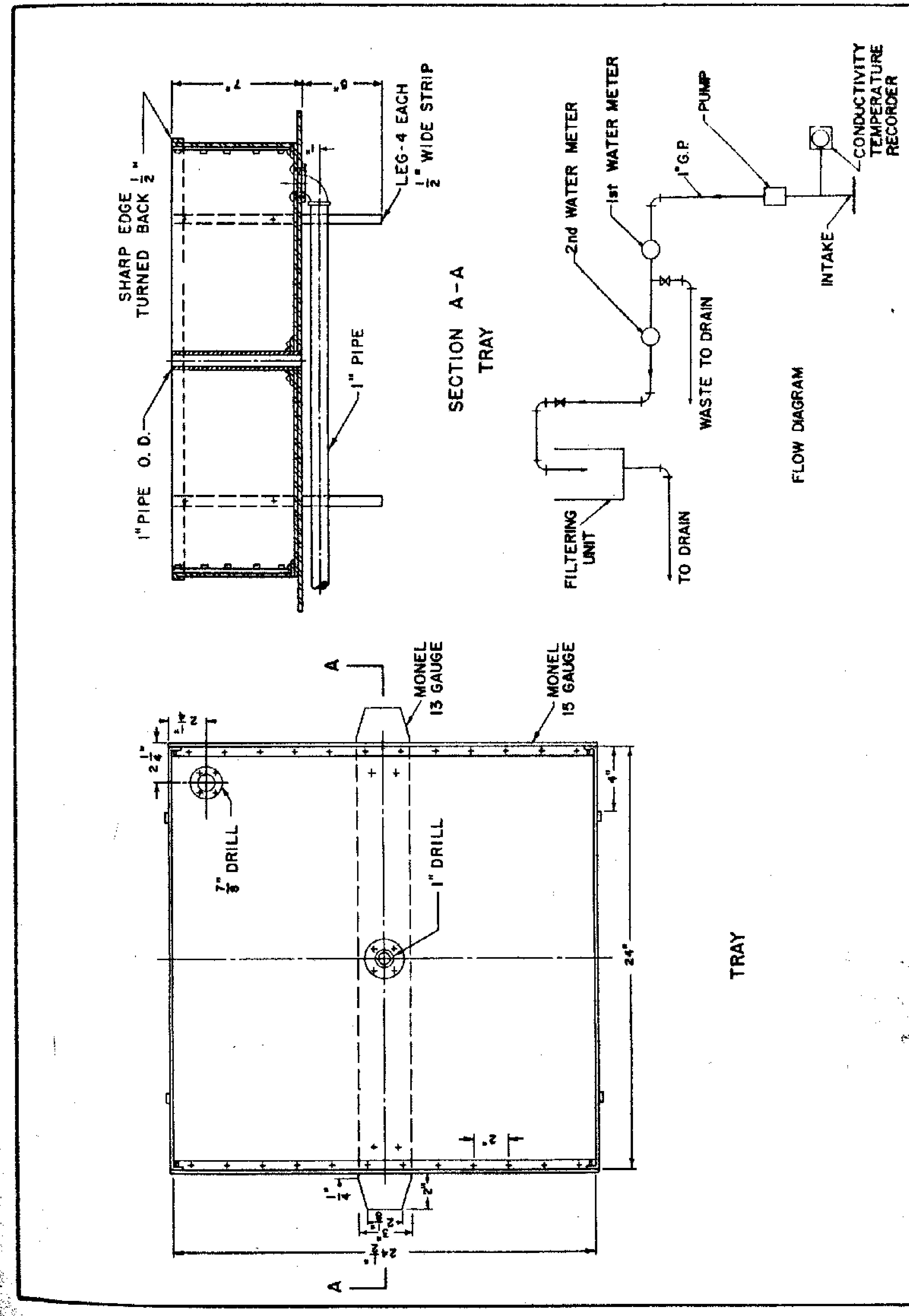

FIGURE 3

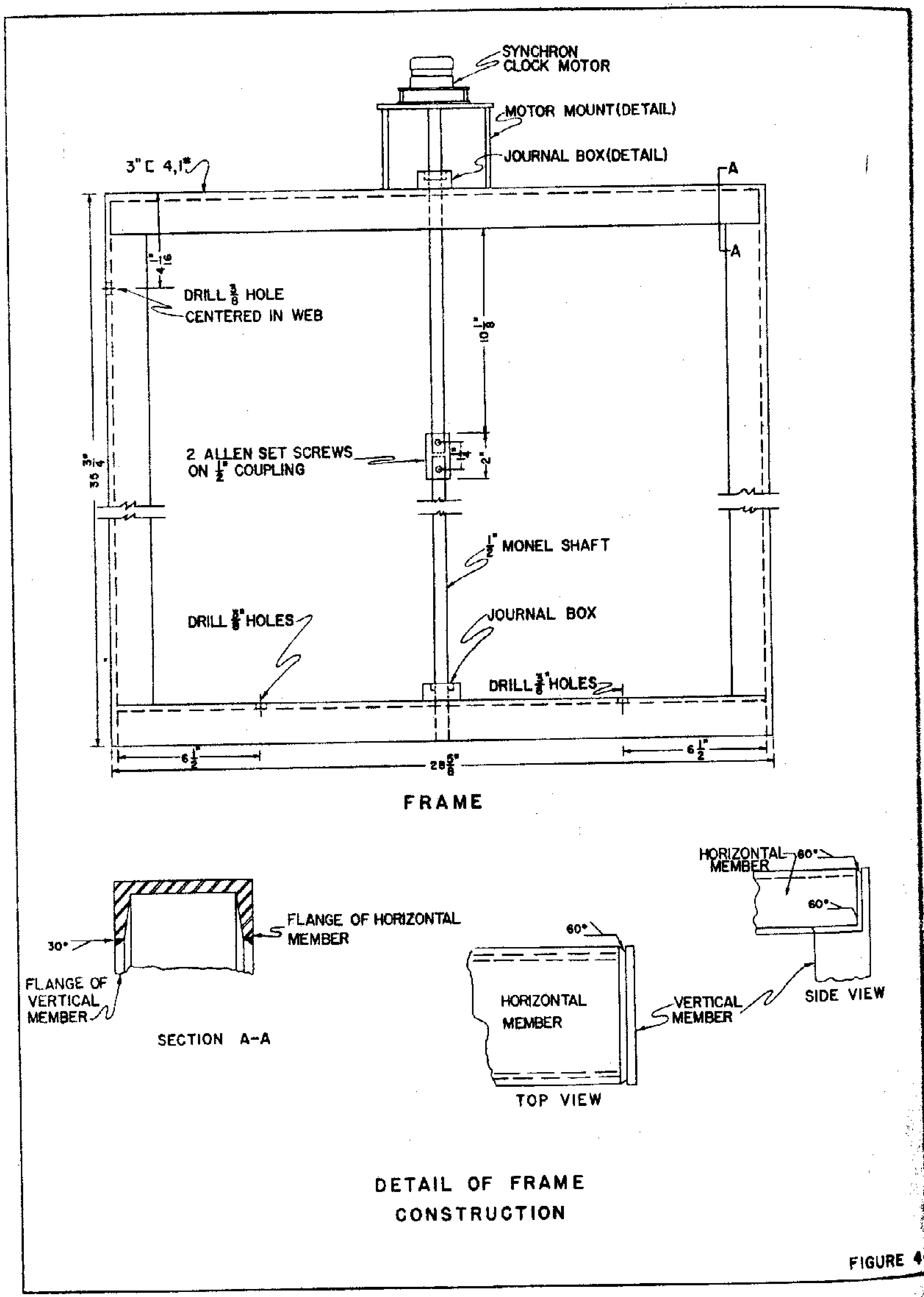

FIGURE 4

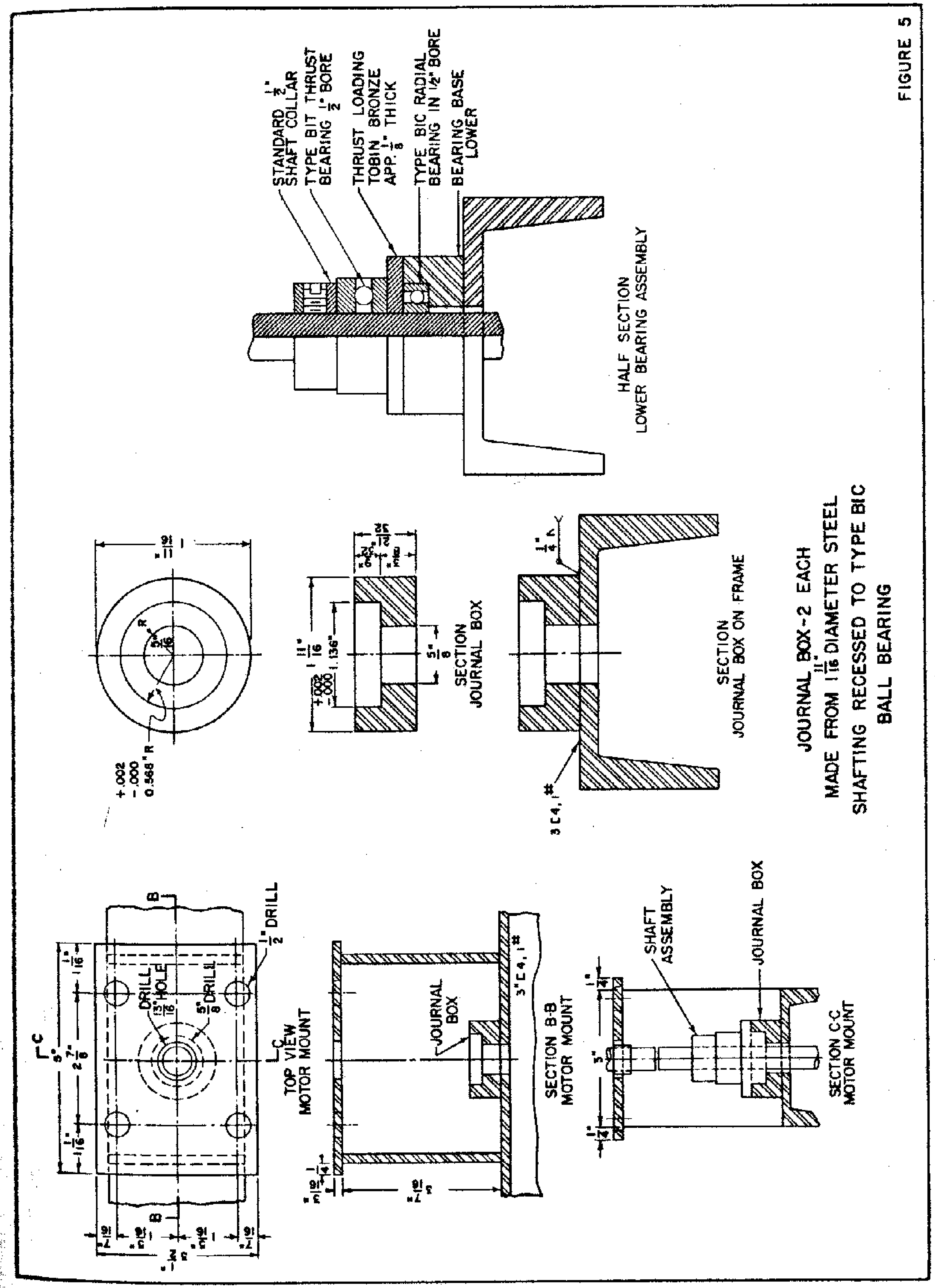

FIGURE 5

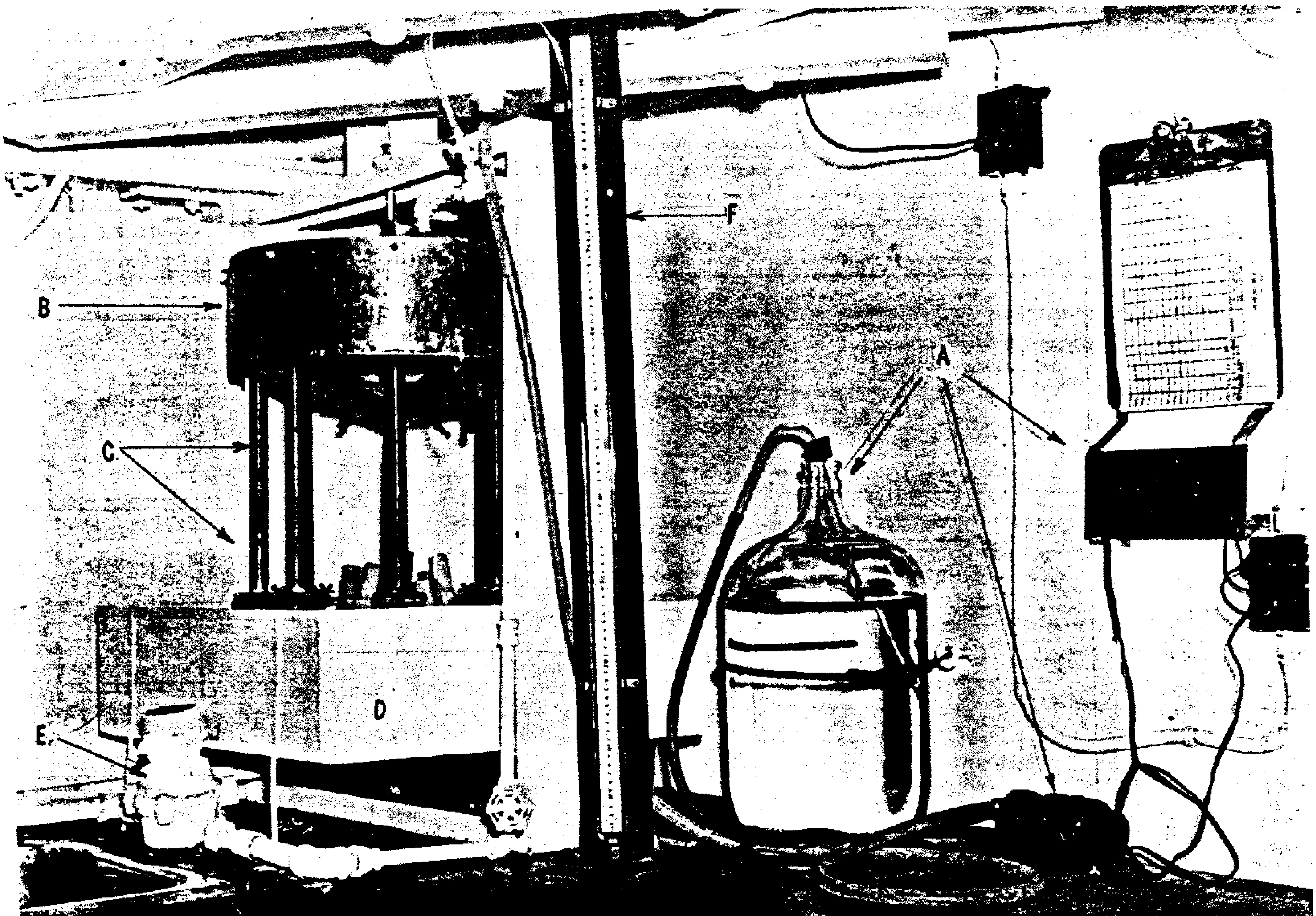

Figure 6.- The G-II semi-automatic plankton sampler as installed aboard M/V ALASKA. A - preservative dispensing system, B - filtering pan, C - filter tubes and assemblies, D - tray; E - second water meter. F - manometer. See drawings for details.

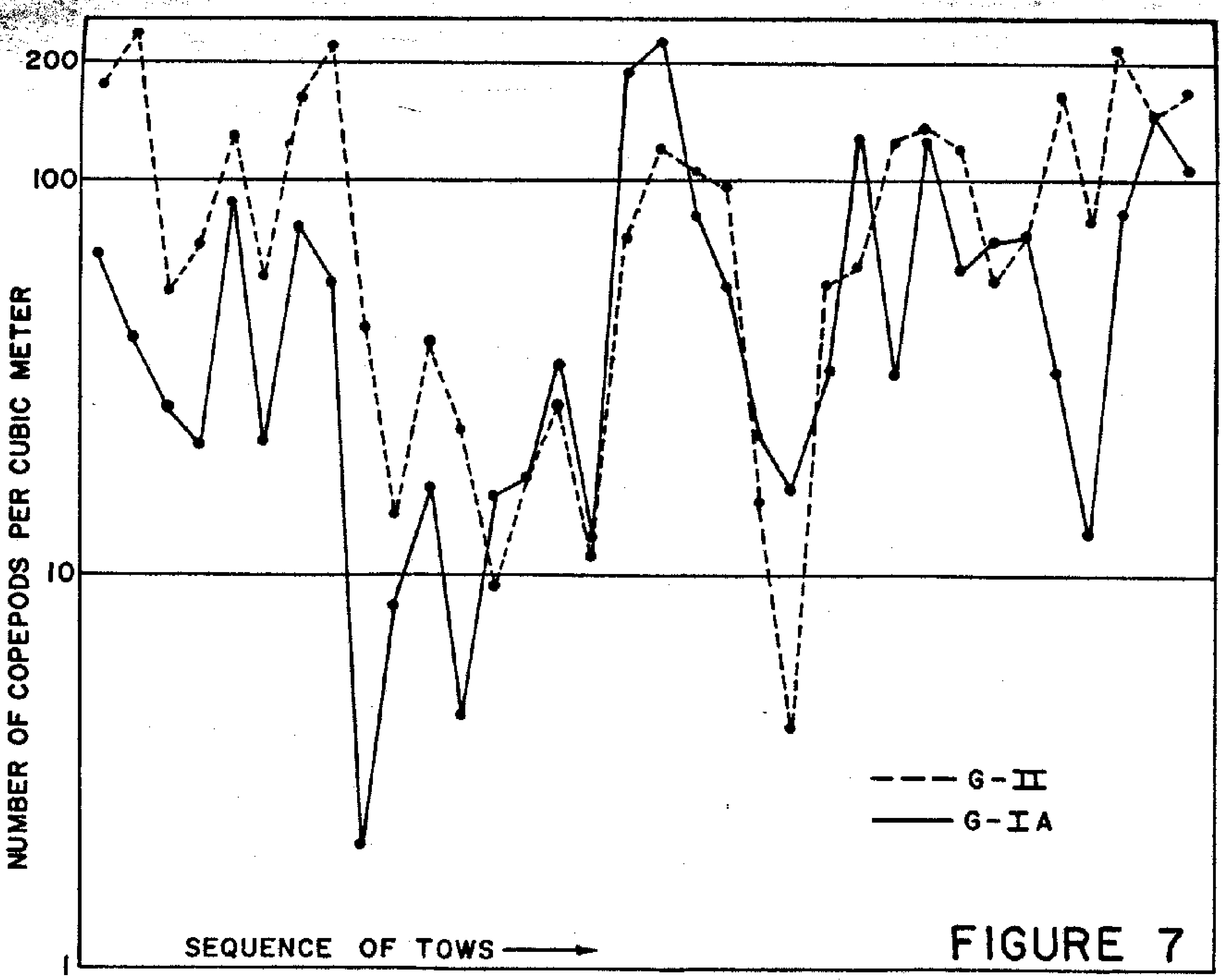

FIGURE 7

--Comparison of concentrations of copepods as determined by use of the G-IA and G-II plankton samplers. Data from Cruise 5 of the U. S. Fish and Wildlife Service M/V ALASKA. The points represent stations which are shown in sequence from left to right. Semilog.